DOCUMENT RESUME

ED 333 737 FL 019 232

AUTHOR Appel, Gabriela; Lantolf, James P.
TITLE Cognitive Complexity and Second Language Speech Production.
PUB DATE 91
NOTE 23p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Cognitive Processes; Comparative Analysis; Difficulty Level; *English (Second Language); Higher Education; Language Research; *Language Skills; Linguistic Theory; *Oral Language; Recall (Psychology); *Second Language Learning; Short Term Memory

ABSTRACT

A study compared the effects of cognitive complexity on the speech production of 14 advanced non-native speakers of English and 14 native English-speakers. Cognitively simple and complex tasks were distinguished based on text type (narrative versus expository). Subjects read one narrative and one expository text in separate sessions, then wrote about the texts (short-term recall), had an unrelated conversation, and were asked to reproduce the texts orally. Three types of measure were used: fluency measures (pause length, phonation time, speech rate, articulation, phrase length), proposition recall measures (recall of simple propositions in the text in question), and reading time. Results indicate that the native English speakers (L1s) recalled an equal percentage of propositions on both text types, and the non-native speakers (L2s) recalled a higher proportion of propositions in the narrative text, suggesting that cognitive complexity has a more robust effect on L2s than L1s. In addition, it was found that fluency (speech rate and phrase length) varied significantly for both L1s and L2s across text types, while articulation rate varied for L2s only. A subtle effect appeared in the interaction between phonation time and the number of propositions reproduced in both groups. Subjects' private speech emerged as a significant factor. (MSE)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED333737

Cognitive Complexity and Second Language Speech Production

Gabriela Appel and James P. Lantolf
Cornell University

Introduction

Our primary goal in this paper is to present a psycholinguistic analysis of the interaction between cognitive complexity and speech production in a second language.[1] To this end we explore the effects of cognitive complexity, operationalized as text type, on measures of fluency in the recall protocols of L1 and L2 speakers of English. Secondarily, we intend to bring to light a source of evidence on mental processing that heretofore has not received the attention it deserves in either the L1 or L2 literature.

Study of the effects of text type (e.g., narrative vs. expository; cause-effect vs. description) on L2 performance is certainly not new. The growing body of research on L2 reading and writing processes is clear attestation to this fact (see, for instance, Carrell, et al, 1988 and Connor & Kaplan, 1987). To our knowledge, however, the L2 text literature has focused almost exclusively on issues relating to propositional, discourse and other rhetorical phenomena. Some L2 researchers, indeed, have studied speech production phenomena; however, this research is based exclusively on narrative recall tasks (see Dechert, et al 1984 and Dechert & Raupach, 1980a and b, Lennon 1990). To our knowledge, no study has investigated the effects of text type on L1 and L2 speech production.

Although none of the L2 speech production research has focused on the effects of cognitive complexity, we have nevertheless, been able to find two studies in the L2 literature (Ellis, 1985 and Zhang, 1987) in which the notion of cognitive complexity, although operationalized somewhat differently than in the present study, has been examined for its potential effects on L2 performance. Both of these studies, to be briefly described below, deal with less advanced speakers than is the case here; and both focus on linguistic features rather than on production phenomena.

Previous Research on Cognitive Complexity in L2

The studies by Ellis and Zhang both operationalize cognitive complexity in terms of differential questioning patterns and subsequently analyze learners' spoken or written responses to questions designed to be cognitively simple or complex. Ellis (1985, p. 89) points out that for children, questions about the here and now, such as "What things can you see on the table?" are less complex than questions displaced in time and space, such as "What happens to the cookies when we put them in the oven?" Similarly, for Zhang (1987) "questions calling for mere recognition, recall or comprehension of factual information are at the lower level of complexity. The more difficult questions, activating such cognitive operations as analysis, synthesis, abstraction, ratiocination, conjecture or evaluation are at higher levels" (pp. 469-470). Thus, Zhang (pp. 471-472)

FL019232

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☑ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.

BEST COPY AVAILABLE

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Appel; Lantolf
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

differentiates between such low complexity questions as "Where is the man standing ?" and high complexity questions like "What problems might prevent his plan from working?"

Although Zhang and Ellis propose similar definitions of cognitive complexity and employ similar questioning techniques to elicit responses from their subjects, their respective studies reach different conclusions on the effects of this factor on interlanguage performance. Ellis reports a decline in target language accuracy among his school-aged subjects as they respond to increasingly complex questions. Zhang's university subjects, on the other hand, produce more writing in response to cognitively complex questions as compared to less complex questions. Moreover, when comparing responses to cognitively simple versus cognitively complex questions, Zhang reports that his subjects produce syntactically more complex writing, measured by coordinate and subordinate structures, in the latter case. This finding is not all that surprising, since complex tasks can be expected to mobilize "more complex intellectual operations" which "eventually lead to a more complex sort of verbalization" (p. 477).

Somewhat more surprising, and in contradiction to Ellis' finding, however, is that Zhang found no significant difference in linguistic accuracy as his task increased in cognitive complexity. To be more precise, "although the actual number of errors does increase as the total amount of written English increases, there is no significant qualitative difference, in terms of error incidence, between the rather extended, syntactically more complex answers to high cognitive questions and the short and simple reponses to low cognitive questions" (Zhang, 1987, p. 477).

Unfortunately, Zhang provides statistical data only on error incidence and does not inform us as to the nature of the errors committed by his subjects as cognitive complexity varies. In other words, we do not know if the same or different types of errors emerged under the different conditions. Furthermore, since Ellis' task involved oral production, while Zhang's was a written task, the difference in medium could have accounted for a portion of the discrepancy in the findings of the two studies. Finally, we cannot take lightly the maturational difference between the subjects in the respective studies.

The Study

In what follows we present the results of a study on the effects of cognitive complexity on the speech production of advanced non-native speakers of English as a second language. As will become apparent, the effects of this factor are quite complex and subtle.

Definition of Cognitive Complexity

In the present study, we operationalize the distinction between cognitively simple and cognitively complex tasks in terms of text type, specifically narrative versus expository texts. The

text processing literature clearly shows that narrative and expository texts differ with regard to relative level of cognitive complexity. As Britton, et al (1985, p. 227) observe, "the comprehension of scientific and technical expository text is a cognitively demanding task", because "the reader must possess and be able to call upon large bodies of specialized knowledge ... and ... the reader must be able to concurrently carry out a variety of component reading processes and memory management processes", both of which are "cognitive activities that place concurrent demands on the reader's limited cognitive capacity" (p. 228).[2]

Comparatively speaking, the processing of narrative texts is generally considered by cognitive researchers to be a less complex type of mental activity than that entailed in the processing of expository texts. Among the reasons frequently cited for the difference is that narrative texts usually manifest a readily identifiable structure or schema, and people do rely heavily on knowledge of human actions that most humans posess as a result of their activity in the everyday world (Voss & Bisanz, 1985, p. 178). To be sure, specialized knowledge (e.g., knowing something about baseball) has been shown to play a role in the processing of narratives, but such knowledge is nowhere near as central in this case as it is in the processing of expository texts. To once again cite Voss and Bisanz (1985), "unlike narratives, for expository texts there is no single knowledge domain, like knowledge of human actions, that can be expected to provide insights into the way most expository texts are understood when knowledge of structure is not guiding expectations. In theory, expository texts can focus on any knowledge domain" (p. 190).

Evidence of the relative cognitive status of narrative and expository texts also can be found in the developmental literature. According to Mandler and Johnson (1977), for example, children as young as six years of age have little difficulty in recalling the events of a well-formed fairytale. Scinto (1986) cites a number of studies which consistently "point to a disparity in ability to deal equally well with these two [narrative and expository] functional text types at a given age and grade level. The data are suggestive of the fact that ability to produce expository text (the scholarized norm) enters a subject's linguistic repertoire at later states of development" p. 136). Finally, according to Smirnov (1973, p. 48), one type of material which is notoriously difficult for subjects to remember is anything that is formulaic, contains specific terms, or is numerical in nature. Descriptive expository texts, such as the one used in the present study -- Care and Propagation of Arabian Coffee Plants -- are more or less loose-knit listings of information and are not unlike instructions, etc. that need to be followed explicity and in a set sequence.

Task and Procedure

Given the above operational definition of cognitive

complexity, the present study utilizes a reading and recall task of one narrative and one expository text. The narrative text is framed in classic fairytale schema and contains 384 words. It contains three characters, a king, his daughter and a prince disguised as a beggar and treats a typical story theme: the marriage of the princess to the beggar, who later turns out to be a prince. The expository text is a brief passage containing 180 words which describes the care of Arabian coffee plants. The texts are given in the Appendix.

Subjects were administered each of the texts individually in two separate sessions. In the first session, each subject was asked to read the narrative text and attend to its contents, since he/she would be later asked to reproduce the text. No time restrictions were imposed on subjects; each was allowed to take as much time as necessary to read the text. After the subject had finished reading, the text was put aside and the subject was asked to write down in a short, but complete, sentence what the text was about. To control for possible effects of immediate short-term recall, this activity was followed by a three-minute intervening task in which the subject was engaged in a conversation by one of the researchers.[3] Subsequently, the subject was asked to reproduce the text orally. Two days later, the same procedure was followed for the expository text. All reproductions were tape-recorded for later transcription and analysis.

Subjects

Since our focus in this study is on speech production phenomena rather than on linguistic performance, it is essential that our subjects be sufficiently proficient in their second language in order to minimize potential contamination of their production that may arise from linguistic difficulties. With less proficient speakers this is quite likely to be the case. This assumption is based on evidence from an earlier version of this study, which involved L2 speakers of German whom we had initially identified as advanced speakers of the language. It turned out, however, that their proficiency was not sufficiently stable to complete either of the tasks without a significant breakdown in performance. This is not to say that no language effects are to be found in the linguistic performance of our subjects. We have every reason to believe this to be the case. However, we expect these effects to be much more subtle, and perhaps even more interesting, than what has been found in the variation research on less advanded speakers of a second language. Be that as it may, this is a topic for further study.

Twenty-eight subjects, evenly divided between native and non-native speakers of English, participated in the study. The non-native group consisted of 14 university-level speakers of L1 German. They ranged in age from 21 to 29. All were advanced L2 speakers majoring in English studies at Kassel University and all had spent at least one year of study in an English-speaking country. The native group comprised 14 graduate or undergraduate

American university students ranging in age from 19 to 38. All of these were advanced second language speakers of German.

Measures

Two types of measures are utilized in this study: fluency measures, on the one hand, and proposition recall measures on the other. We include, as an additional measure, reading time. The measures of fluency are pause length, phonation time, speech rate, articulation, and phrase length. These measures, coallesced under the general term temporal variables, represent a means for assessing the relative fluency of speech production and a means for observing the mental planning that occurs during text processing.

The systematic study of the temporal aspects of speech, pauses in particular, as indicators of ongoing cognitive processes first appears in the work of the British psycholinguist Goldman-Eisler (1968), who reasoned that time is a key element in real speech events. She argues that periods of external inactivity, i.e., silence, is indicative of an individual's internal activity, specifically the activity of planning stages of utterances, "hesitation is to be taken as behaviour which is synchronous with, and indicative of, encoding processes responsible for generation of information" (Goldman-Eisler, 1968, p. 51).

The sound-silence pattern which marks speech is not stable. It varies from speaker to speaker as well as within one speaker at different points in time under different circumstances. The discontinuous character of speech becomes immediately obvious when speech is produced spontaneously (i.e., unplanned speech, see Crookes, 1989). The impression of smoothness which people often retain when listening to someone speak is rarely supported when speech is examined closely. Speakers seldom produce flawless strings of words; rather, they repeat themselves, backtrack to alter, or correct, parts of their utterances, occasionally slip and produce speech errors, and they also execute syllables such as uh, and ah, to which no meaning is usually assigned.[4] We briefly define the variables to be analyzed.

Reading time -- the total time it takes to complete reading a text. We made no attempt to limit the amount of time subjects spent reading a text. They were allowed as much time as they felt necessary. This means, of course, that subjects had the opportunity to read each text more than once. We report reading time in seconds.

Recall of Propositions -- using the system developed by Bovair and Kieras (1985), we computed the total number of simple propositions in each of the two texts. A proposition consists of a predicate and one of more arguments belonging to the predicate. The narrative text contains 97 propositions and the expository texts contains 52 propositions. To measure propositional recall, we counted the number of propositions contained in the protocols produced by each subject for each of the two text types.

Fluency Measures --Temporal Variables

Phonation time -- the actual amount of time used by a subject for vocalization. It is calculated by substracting the unfilled and filled pause time from total production time, and is measured in seconds.

Speech rate -- is an index expressing the number of syllabes produced per second of production time. Since it behaves in a neutral way with regard to the structural aspects of languages, the syllable is widely recognized as the basic unit of speech in the production literature.

Articulation rate -- is an index of the number of syllables produced per second of phonation time. This measure excludes pause time.

Phrase length -- denotes the stretches of speech between two pauses. These stretches might cover a word, a phrase, a clause, or an entire sentence, or they might not exceed the length of a syllable. Phrase length is obtained by dividing the total number of syllables produced by the number of pauses +1.

Research Questions

Given what is known about the relative complexity of narrative and expository texts, we asked two questions regarding the effects of this complexity on recall and speech production:

1. Does text type have a differential effect on the recall of propositions across L1 and very advanced L2 speakers of a language?
2. Does text type have a differential effect on the speech production, as assessed by our four measures of fluency, across L1 and very advanced L2 speakers during recall tasks ?

As will become apparent, although the answer to both questions is, in essence, affirmative, the findings of our analysis paint a more complex, and interesting picture, than may, at first, be anticipated.

DATA ANALYSIS

Reading Time and Propositional Analysis

In order to set the stage for our analysis of temporal variables and to determine the potential role of cognitive complexity in speech production, we first compare the number of propositions accurately recalled by both the native and the non-native groups across text types (Table 1).

Neither group performed particularly well in their attempts to recall the expository text. Of the total number of propositions (n=52) contained in this text, the L1 group recalled slightly over 50% of them, while the L2 subjects, recalled just over 40% text. The difference between the groups was not significant. For the narrative protocols, however, the picture changes significantly. Once again, the native speakers produced

just over 51% of the total number of propositions (n=97) contained in the narrative text, but the L2 subjects accurately recalled approximately 66% of the protocols. Furthermore, the number of propositions recalled from the narrative text by the L1 group ranged from a low of 23 to a high of 70. For the L2 group, on the other hand, the range extended from a low of 37 to a high of 84. The difference between the groups is significant.

Table 1
Comparison of Recalled Propositions Across Text Type and Group

Group	L1 (n=14)		L2 (n=14)			
	$\bar{X}$	SD	$\bar{X}$	SD	t	p
Expos (n=52)	27.79 (53.44%)	12.75	22.86 (43.96%)	8.08	1.65	ns
Narr (n=92)	49.79 (51.79%)	7.58	59.79 (66.34%)	13.63	1.95	.025

If we now look at the reading times for both groups across text types, we can begin to understand why the groups performed as they did with regard to the number of propositions recalled (Table 2). In both instances, the native speakers show a significantly lower reading time than their non-native counterparts. It is interesting to note, however, that the difference in reading time for the native speakers increased by only 3 seconds on the expository as compared to the narrative text. The L2 subjects, on the other hand, while slower than the natives in both cases, increased their reading time by 1 minute and 18 seconds when reading the expository text.

It seems as if the L2 speakers were more sensitive to the difference in text type than were the natives. That is, the natives focused an equal amount of time on reading both texts, and were not overly successful in recalling the propositional content of either. To be sure, they outperformed the non-natives on the expository text; still, as a group, they were only able to reproduce just over half of the propositional content of the passage. On the other hand, the fact remains that the L2 subjects took nearly twice as long as the natives to read the expository text and were only able to recall less than half of the propositions.

Table 2
Comparison of Mean Reading Times for L1 and L2 Groups Across Text Type*

Group	L1		L2			
	RT	SD	RT	SD	t	p
Expos	194.4	61.8	370.8	141	4.26	.001
Narr	191.4	144	292.2	114	1.98	.025

*Reading times reported in seconds

On the narrative passage, the non-native speakers significantly outperformed the native-speaking group with regard to the number of propositions recalled, all be it at the expense of a longer reading time. Furthermore, an examination of each of the protocols produced by the individual members of both groups shows that a greater number of the L2 speakers reproduced the propositions according to the sequence in which they appeared in the original text. A similar finding was reported in Connor and McCagg (1987) for Japanese- and Spanish-speaking learners of English. Although Connor and McGagg are not able to explain this phenomenon, they do comment that the L1 speakers "apparently felt free to rearrange the information" (p. 77). While we are not in a position to refute Connor and McCagg's account of the relative performance of their L1 and L2 subjects, we believe there may be more at work than simply the native speakers' sense of freedom to rearrange the events of a story.

Smirnov (1973) discusses what he refers to as "the mnemonic orientation" of the individual, which is a conscious, and even occasionally unconscious, intention to memorize. According to Smirnov, "the presence of the mnemonic orientation is of great importance for the productivity of memorization. The intention to remember must be considered one of the most important conditions for the success of memorization. Furthermore, with an orientation towards completeness, the material to be memorized can also evoke an orientation toward remembering the sequence in which it is given" (p. 27). Without an orientation to sequence, the material to be remberered loses much of its importance and meaning. Smirnov (p. 49) points out, however, that in itself material does not evoke a strictly defined mnemonic task, if there is no subjective attitude towards the material which corresponds to a particular orientation.

In view of Smirnov's claims, we suggest that the difference in recall performance on the narrative task, in favor of the L2 speakers, results not from the natives' "sense of freedom", but from the L2 speakers' orientation to remember. The source of this orientation can, we believe, be traced to the prior language learning experience of the two groups of speakers. As far as we can tell, it is not common classroom practice in the American

educational system to call upon students to read and retell stories in either their native, or a foreign, language. German students, on the other hand, have extensive experience with such tasks during foreign language study, beginning as early as the middle school years. It is, therefore, not inconceivable that having been well-rehearsed in the task of retelling stories in a foreign language, the German subjects approached the task with a mnemonic orientation and therefore were able to recall a higher percentage of the proposition and in the correct sequence than their American counterparts.

Thus, it appears that the label "native speaker" does not, in itself, imbue one with privileged status with regard to linguistic performance. In a study of Chinese-speaking learners of English, Chen (1990) likewise reports that his L2 subjects recalled a significantly higher number of propositions from expository texts of varying complexity in a written recall task than did his L1 subjects. He attributes the L2 advantage to the fact that these subjects, unlike in many studies comparing L1 and L2 speakers of English, were not enrolled in a compensatory course; rather they were all enrolled in regular graduate-level courses and had been in the U.S. for at least two years. Furthermore, the Chinese students in his study had to enter an intense competition in their homeland before they were permitted to study abroad. Thus, they had to be at the top of the competition both in academic and English abilities to be chosen.

Finally, when we consider the relationship between reading time and number of propositions recalled, we observe weak non-significant correlations between reading time and propositional recall for the L1 speakers on both the expository as well as the narrative text ($r=.18$, $p=ns$ for the former; $r=.23$, $p=ns$ for the latter). In the case of the L2 group, however, the relationship between reading time and propositional recall is quite different. For the narrative text, a modest, and significant correlation was obtained ($r=.45$, $p<.05$), and for the expository text, a fairly strong and significant correlation was observed ($r=.61$; $p<.01$). This we interpret as further evidence that the L2 subjects were more sensitive to text type differences than were the L1 speakers, and were much more strongly oriented to memorize, even though the expository text caused them considerable problems, because of its loose structural organization.

TEMPORAL VARIABLES

Phonation Time and Propositional Recall

In view of the relationship between reading time and propositional recall considered in the previous section, it is worth looking at the data uncovered for phonation time and propositonal recall. It will be remembered that phonation time is a measure of the total amount of time a subject spends vocalizing during a task and is calculated by subtracting the total pause time from the total time it takes a subject to produce the recall protocal. Table 3 presents a comparison of the phonation time for

the two subject groups across text types.

Table 3
Mean Phonation Time for Text Types*

Group	L1		L2			
	$\bar{X}$	SD	$\bar{X}$	SD	t	p
Expos	54.98	16.16	58.99	24.6	.59	ns
Narr	84.55	24	120.54	19.8	4.37	.001

*Time reported in seconds

For both groups the mean phonation time on the expository text was just under 1 minute duration, and no significant difference was found between the groups on this measure. In the case of the narrative passage, however, a significant group difference was found, with the L2 speakers taking just over two minutes, on average, to reproduce the story, while the L1 subjects took about one and one-half minute. The relevance of this difference becomes clearer when we compare phonation time to total production time.

The mean total speaking time for each group on the expository text was 90.79 sec. for L1 subjects and 115.60 sec. for the L2 speakers. The difference between phonation time, given in Table 3, and total speaking time for the L1 speakers is 36 sec., or in other words, they were silent about 40% of the time during the expository recall. For the L2 group, the difference between phonation time and total speaking time is approximately 57 sec., which means they were silent for nearly 50% of the time during recall. Thus, even though the difference in phonation time between the groups was not significant on the expository recall, the L2 group spent more time in silence, presumably engaged in planning strategies -- a sign that, for them, the task was more difficult.

Turning to the narrative text, we find that the difference between a total speaking time of 130.43 for the L1 speakers and their mean phonation time, given in Table 3, is about 46 sec., indicating that they were silent approximately 35% of the time. For the L2 group, the difference between a mean speaking time of 193.56 sec. and their mean phonation time, seen in Table 3, is 73 sec., indicating that they remained silent about 38% of the time. Thus, both groups spent a more or less equal proportion of their overall time in silence, as they attempted to recall the narrative passage.

It will be remembered, however, that the L2 speakers reproduced a significantly higher number of the propositions contained in the original narrative than did the L1 subjects. For the expository recall, there was no significant difference found between the groups on this measure, with both groups performing

rather poorly. In view of these facts, one might suspect there to be a correlation between phonation time and number of propositions recalled for the L2 speakers. As Table 4, in fact, shows, a moderate, but significant, correlation was obtained between the two measures for the L2 subjects in the case of narrative recall.

Table 4
Correlation between Phonation Time and
Number of Propositions Recalled

Text Type	L1	L2
Expository		
PT x No. of Prop	.193 (ns)	.332 (ns)
Narrative		
PT x No. of Prop	.152 (ns)	.487 ($p<.05$)*

We believe that the correlational data (phonation time and number of propositions recalled) further corroborates our earlier claim that the L2 speakers recalled a greater number of propositions from the narrative passage than did the natives, because of their orientation to remember. The differences in phonation time and number of propositions recalled are important for other reasons. They point to a source of data, beyond quantified measures (pauses, speech rate, etc.) that bears heavily on our understanding of processing strategies. We will consider these data later.

MEASURES OF FLUENCY

Phrase Length

This variable, it will be remembered, is computed by dividing the total number of syllables produced by the number of pauses +1. Since phrase length entails both pauses and production phenomena, it is a much more sensitive measure of fluency than is either total pause time or phonation time. While people frequently pause to plan what and how to say something, there are many other reasons why people pause during speech production (loss of attention, strategic effect, an individual's personal speaking style etc). Thus, we cannot be absolutely certain as to the significance of the amount of silence generated during any given speech event. Phrase length, or the amount of speech produced between pauses, on the other hand, can give us a much better handle on the problems a speaker might have during production and thus represents a more appropriate measure of fluency. Table 5 provides a comparison of the mean phrase length obtained for both groups across text types.

Table 5
Comparison of Mean Phrase Length*

Group	L1		L2			
	$\bar{X}$	SD	$\bar{X}$	SD	t	p
Expos	5.27	.807	4.14	.877	3.32	.005
Narr	6.92	1.09	5.88	1.53	2.13	.025
t	4.34		3.55			
p	.001		.001			

*Reported as number of syllables between pauses

Table 5 shows that the speech produced by the L1 subjects on both recall tasks was more fluent than that produced by the L2 subjects. In other words, the natives produced significantly longer stretches of speech before pausing than did the non-natives, regardless of text type. Furthermore, as Table 5 also reveals, both groups produced less fluent speech on the expository recall task than on the narrative passage.

Speech Rate and Articulation Rate

Recall that both the speech rate and articulation rate are measures of fluency computed on the basis of syllable production. Speech rate (Table 6) displays the number of syllables produced per second of total speaking time, and therefore does not exclude pauses from its calculation. Articulation rate (Table 7), on the other hand, excludes pause time, and is consequently a more sensitive measure, since it expresses the number of syllables produced per second of phonation time.

Table 6
Mean Speech Rate Across Text Types

Group	L1		L2		t	p
Expos	$\bar{X}$	SD	$\bar{X}$	SD		
	2.28	.43	1.77	.41	3.71	.001
Narr	3.06	.46	2.43	.424	3.19	.001
t	4.88		4.13			
p	.001		.001			

Table 7
Comparison of Articulation Rate Across Text Types and Groups

Group	L1		L2		t	p
Expos	$\bar{X}$	SD	$\bar{X}$	SD		
	4.52	.93	3.29	.45	4.24	.001
Narr	4.71	.51	3.72	.46	4.95	.001
t	.601		2.53			
p	ns		.01			

As seen in Tables 6 and 7, the native speakers had a significantly higher speech rate and articulation rate than did the L2 subjects across both text types. When we look across text types within groups, we observe that in the case of speech rate, text type was significant for both groups of speakers. For the more relevant articulation rate variable, however, a significant difference was obtained only for the non-native speakers.

DISCUSSION AND CONCLUSIONS

We begin by looking first at our original research questions. The questions are repeated here for convenience:

1. Does text type, i.e., shifts in cognitive complexity, have a differential effect on the recall of propositions across L1 and L2 speakers ?
2. Does text type have a differential effect on fluency -- speech production -- as measured by specific temporal variables of L1 and L2 speakers ?

The answer to the first question is yes and no, depending on whether L1 or L2 speakers are engaged in the recall task. The L1 speakers recalled an equal percentage of propositions on both tasks (53% on the narrative task and 52% on the expository passage). The L2 speakers, on the other hand, recalled a higher percentage of propositions on the narrative than on the expository recall task (66% and 44%, respectively). Thus, cognitive complexity appears to have a more robust effect on L2 than on L1 speakers. However, the L2 speakers clearly outperformed the L1 speakers on the narrative task and the L1 speakers performed somewhat better than the L2 speakers on the expository task.

The answer to the second question is somewhat more complicated. Fluency, as measured by speech rate and phrase length, varied significantly for both L1 and L2 speakers across cognitive tasks. Articulation rate, however, showed significant

variation for the L2 subjects only. The fact that articulation rate did not vary significantly for the L1 speakers from one passage to the other is not surprising, since, as documented in other production literature, this measure tends to be more or less stable compared to other measures of fluency. Thus, the fact that articulation rate shows significant variation for L2 speakers is a key indication that, generally, their speech production was more influenced by task variation than was that of their L1 counterparts. We conclude that task difficulty made a greater impact on fluency for L2 than for L1 speakers. Nevertheless, in terms of number of propositions recalled, the L2 subjects were better at reproducing one (i.e., narrative) of the two texts than were the natives.

A subtle, although potentially very interesting effect appeared in the interaction between phonation time and number of propositions reproduced by the groups. Recall that for the narrative passage, the L2 speakers produced a significantly greater number of original propositions than did the L1 group (Table 1). Also recall that for the L2 speakers, but not for the L1 speakers, a significant correlation was observed between phonation time and number of propositions reproduced for the same task. This means that the natives produced more speech but fewer of the original propositions. Thus, some of their speaking activity must not have contributed to carrying the text forward.

Closer scrutiny of the protocols for both text types reveals that the on the narrative text, the L1 speakers indeed generated a higher number of metacomments, or what we prefer to call private speech (PS), than did the non-natives. The native group produced an average of 4.4 instances of PS on the narrative task, while their non-native counterparts produced a mean of only 1.93 metacomments. The natives thus produced more fluent, but less text linked speech than did the L2 speakers. As we have already argued, the reason for this may be lack of experience with such tasks on the part of the native group.

We offer the three instances of PS from the L1 narrative protocols. One subject relating King Arnold's vow to give his daughter in marriage to the first person to enter the room says,

> "I swear to God the first man that ... come [sic] in here this this certain ability that ... <u>I forgotten</u> ... will give her hand in marriage."

Another speaker was unable to remember the princess' name, and so remarked, "The daughter's name was ... <u>oh well that doesn't matter ... Anyway</u> for her twentieth birthday ... ." A third speaker had difficulty with Grace's age, and stated "Grace is ... <u>I think</u> twenty years old." Such speech was observed only sporadically among the protocols of the L2 subjects.

In the case of the expository protocols, we observed that both groups were rather unsuccessful in reproducing the propositional content of the original text. They both experienced considerable difficulty, as indicated by the differences in

measures of temporal variables across text types. Consequently, if our claim is correct, we would expect a higher incidence of PS for both groups on the expository recall task. Although the L2 speakers indeed produced more private speech (X=4.43), the natives produced approximately the same amount as they did for the narrative passages (X=4.53). We conclude from this the expository text was equally difficult for both groups to reproduce and most of their production time was taken up by pauses and private speech rather than textually related speech.

Connor and McCagg (1987,p. 78) report that on a written expository paraphrase task in English, their L1 and their Spanish-speaking L2 subjects produced significantly more metacomments involving personal perspective and changes in perspective than did their Japanese-speaking subjects. Although we cannot comment in detail on this data, it is possible that the metacomments observed by Connor and McCagg could function as a type of Private Speech. These researchers do, neventheless, raise an intriguing point well worth pursuing in light of our findings. Citing the research of Tannen (1980) on differences between Greek and American rhetorical styles, they suggest that perhaps the appearance of metaspeech might be somehow culturally bound (p. 78). Recently, McCafferty (in press) reports a significant difference in the frequency of strategic private speech produced by a group of Hispanic-background subjects, on the one hand, and Asian-background subjects, on the other, as they attempted to relate a picture story in English, their L2.

While temporal variables provide us with crucial information on the mental processes underlying speech production and comprehension, their study has led to what we believe to be an untenable assumption about the relationship between speaking and planning. The production models which emerged as a consequence of the work of Goldman-Eisler and her colleagues assumed a, more or less, neat bifurcation between speaking and silence. Silence signalled planning, and speaking was a manifestation of the result of the planning. We are well aware that speaking and planning can occur simultaneously. However, the assumption has been that this happens because the planning is not very complex and the speech production is simple, stereotypic or automatic (Garman, 1990, p. 132).

Things are not quite so simple. Research within the Vygotskyan paradigm has demonstrated that speaking itself (i.e., private speech) can serve a metacognitive, or planning, or even knowing function (Frawley & Lantolf, 1985, p. 23). It has a function similar to that attributed to pauses, and it emerges at precisely the same point in the speaking process as pauses -- when the speaker experiences difficulty in carrying out a particular task. As Frawley and Lantolf (1985) and Appel (1987) point out, private speech may not only contribute to the planning process; it may also assist comprehension. In other words, we believe that the private speech produced by our subjects, not only signaled production problems, but represented an attempt to comprehend the text by externalizing the inner order through

speech. In other words, some of our subjects did not come to understand the text they had read, or perhaps failed to realize they had not understood it, until they began to speak. Unfortunately, we cannot pursue this somewhat provocative claim further here, and recommend that the reader consult the work of Frawley and Lantolf (1985) and Appel (1987). We would, nevertheless, like to call attention to the potential relevance of PS analysis. Pause analysis, even when coupled with error analysis and other production measures does not, in our view, fully exploit the evidence provided by speakers on strategic mental processing during the conduct of complex mental tasks.

References

Appel, G. (1987). L1 and L2 narrative and expository discourse production: A Vygotskyan analysis. Unpublished doctoral dissertation, University of Delaware, Newark, DE.

Black, J. B. (1985). An exposition on understanding expository text. In B. K. Britton & J. B. Black (Eds.), Understanding expository text: A theoretical and practical handbook for analyzing explanatory text (pp. 249-268). Hillsdale, NJ: Lawrence Erlbaum.

Bovair, S. & Kieras, D. E. (1985). A guide to propositional analysis for research on technical prose. In B. K. Britton & J. B. Black (Eds.), Understanding expository text: A theoretical and practical handbook for analyzing explanatory text (pp. 315-362). Hillsdale, NJ: Lawrence Erlbaum.

Britton, B. K., Glynn, S. M., & Smith, J. W. (1985). Cognitive demands of processing expository text: A cognitive workbench model. In B. K. Britton & J. B. Black (Eds.), Understanding expository text: A theoretical and practical handbook for analyzing explanatory text (pp. 227-248). Hillsdale, NJ: Lawrence Erlbaum.

Chen, Daxing. (1990). Reading in Chinese and English: Effects of formal schema and metacognition. In H. Burmeister & P. L. Rounds (Eds.), Variability in second language acquisition: Proceedings of the tenth meeting of the Second Language Research Forum, vol. 1 (pp. 273-290). Eugene, OR: Department of Linguistics.

Connor, U. & Kaplan, R. B. (Eds.). (1987). Writing across languages: Analysis of L2 text. Reading, MA: Addison-Wesley.

Crookes, G. (1989). Planning and interlanguage variation. Studies in Second Language Acquisition, 11, 367-384.

Dechert, H. W., Mohle, D., & Raupach, M. (Eds.) (1984). Second language productions. Tubingen: Gunter Narr.

Dechert, H. W. & Raupach, M. (Eds.). (1980a). Temporal variables in speech: Studies in honour of Frieda Goldman-Eisler. The Hague: Mouton.

Dechert, H. W. & Raupach, M. (Eds.). (1980b). Towards a cross-linguistic assessment of speech production. Frankfurt: Peter D. Lang.

Ellis, R. (1985). Understanding second language acquisition. Oxford: Oxford University Press.

Ellis, R. (1982). Discourse processes in L2 classroom development. Unpublished doctoral dissertation, University of London.

Frawley, W. & Lantolf, J. P. (1985). Second language discourse: A Vygotskyan perspective. Applied Linguistics, 6, 19-44.

Goldman Eisler, F. (1968). Psycholinguistics. Experiments in spontaneous speech. London: Academic Press.

Lennon, P. (1990). Investigating fluency in EFL: A quantitative approach. Language Learning, 40, 387-417.

Levelt, W. (1989). Speaking. Cambridge, MA: MIT Press.

McCafferty, S. G. (in press). The use of strategic private speech by adult Hispanic and Asian acquirers of English as a second language. In G. Appel & J. P. Lantolf (Eds.), Vygotskyan approaches in second language learning. Norwood, NJ: Ablex.

Mandler, J. M. & Johnson, N. S. Remembrance of things parsed: Story structure and recall. Cognitive Psychology, 9, 111-151.

Scinto, L. F. M. (1986). Written language and psychological development. Orlando: Academic Press.

Smirnov, A. A. (1973). Problems of the psychology of memory. New York: Plenum Press.

Tannen, D. (1980). A Comparative analysis of oral narrative strategies: Athenian Greek and American English. In W. L. Chafe (Ed.), The Pear stories: Cognitive, cultural, and linguistics apsects of narrative production (pp. 51-88). Norwood, NJ: Ablex.

Tarone, E. (1988). Variation in interlanguage. London: Edward Arnold.

Voss, J. F. & Bisanz. (1985). Knowledge and the processing of narrative and expository texts. In B. K. Britton & J. B. Black (Eds.), Understanding expository text: A theoretical and practical handbook for analyzing explanatory text (pp. 173-198). Hillsdaly, NJ: Lawrence Erlbaum.

Vygotsky, L. S. (1986). Thought and language. Cambridge, MA: MIT Press.

Wertsch, J. V. (1985). Vygotsky and the social formation or mind. Cambridge, MA: Harvard University Press.

Zhang, S. (1987). Cognitive complexity and written production in English as a second language. Language Learning, 37, 469-481.

Appendix

Narrative Text

King Arnold had a beautiful daughter called Grace. On her twentieth birthday he invited all the princes from the surroundings areas. He wanted her to choose one of them for a husband. Princess Grace was sweet and quite unspoiled for a person of her rank. Her only defect was, she couldn't make up her mind about anything. Surrounded by twelve eager suitors she was losing her mind trying to decide. The king became so angry over her indecision, he shouted, "I'm tired of your hesitation ! I swear to God I'll give you in marriage to the first man who enters this room !" At that exact moment, a tramp, who had managed to get by the guards, bursts into the hall, yelling, "I heard that! You swore by God! The princess is mine!" The king couldn't go back on his word. The beggar got himself ready for the ceremony. Everyone was surprised to see how well he looked in his borrowed clothes. After a few days, the new husband told his wife the time had come for them to leave the palace in order to return to his poor house and humble work. After traveling for a time they reached a lovely country. Everywhere there were brooks, waterfalls, orchards and vineyards. Every time Grace asked who owned all this, her husband answered "Prince Phillip." At last they stopped in front of a little stone house in the shadow of the castle wall. He told Grace this was their house. He had a job inside the palace but since it didn't pay much he hoped she would help in providing for the household. She could bake bread and sell it in the market place. For a whole year, they lived this way, poor but happy. One evening her husband came home and said, "Tonight we have a chance to make some extra money at a party in the palace to welcome a new princess. I'll leave now, and you join me at eight. I'll be waiting for you at the main entrance." At eight Grace knocked at the front door. She entered the hall. Everything was pitch dark. Suddenly she felt a strong embrace and a tender kiss. A voice she recognized instantly said, "Welcome to your palace, Your Highness. The party is in your honor." (384 words)

Expository Text

At the base of their 4- to 6-inch-long, glossy green leaves, Arabian coffee plants bear clusters of sweetly scented, 3/4-inch white flowers intermittently throughout the year; these mature into pulpy, glistening red, 1/2-inch berries. Within each berry are two seeds, the "beans" from which coffee is made. Plants, which do not begin to blossom or bear fruit until they are three or four years old, grow upright to a height of 4 feet or more unless the tips of stems are pinched off. The Arabian coffee plant does best in curtain-filtered sunlight, night temperatures of 60 to 65 degrees and day temperatures of 70 degrees or higher. Keep the soil evenly moist; fertilize every two weeks from March to October, monthly the rest of the year. Try to avoid touching the leaves, which are thin and tender. Propagate from seeds any

time or from cuttings of upright-growing tips. Do not attempt to propagate from cuttings of side brances, since they generally develop into poorly shaped plants. (180 words)

Notes

1. This paper is a revised version of a paper entitled "Cognitive complexity as a variable factor in interlanguage performance" presented at the Tenth Second Language Research Forum held in March 1991 at the University of Southern California.

2. While the component reading processes include recognition of words and accessing of their meaning, sentence parsing and text integration, the memory management processes comprise activation of relevant textual information and schema prior to and during the reading process (Britton, et al, 1985, p. 228-229).

3. The exact wording of the instructions is as follows: Please read the text that you will be presented with. Attend carefully to its contents, because you will be asked to reproduce the text orally afterwards. You may take as much time as you like reading. When you feel sufficiently familiar with the text, and are ready to reproduce it, please turn over the text sheet.

4. Although the measures employed in this study are drawn from the psychological model of speech production research, one can also identify a more linguistically-based model based largely on the analysis of speech error. Despite the fact that both models use different measures of production, we are, nevertheless, convinced that utlimately the models are not mutually exclusive and can be integrated into a single approach to the study of production processes. For a full discussion of the speech-error model of production, see Levelt (1989). For an informative comparative survey of the two models, see Garman (1990).